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Implant abutments: A review

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Abstract

The increase in the availability of implant restorative components, the selection of an appropriate implant abutment for a given clinical situation has become more challenging. This article describes various abutment systems that will help the practitioner understand the different implant abutments available and therefore be able to understand the selection of abutments for single and multiple unit fixed implant prosthesis

Keywords: Dental implant, abutment, abutment connection

1. Introduction

The use of dental implants to replace the natural tooth has become a common practice in the contemporary restorative and surgical dentistry [1]. In modern dentistry dental implant play most vital role in the replacement of missing teeth. Implants provide excellent support for fixed as well as removable prosthesis, which increases function, compared with conventional complete and partial denture prosthesis and restores esthetics of the patients [2]. Prosthodontic rehabilitation with osseointegrated implant turned out to be the therapeutic solution of choice for treating partially or completely edentulous arches [3]. Implant success is the most desirable aspect which greatly influences the clinical practice and motivates patient to prefer implant supported prosthesis [4].

Implant-supported restorations have become a popular treatment choice for the rehabilitation of the partially edentulous patients. The wide spread adaptation of dental implants have made the clinician to use implant materials and protocols that further expand their use. This has contributed in part to the evolution of "restoration-driven" implant dentistry [5]. In this context, the sound knowledge regarding the implant abutment and the various design principles is an important factor for the dental implant. An abutment is that part of an implant which assembles a prepared tooth and is designed to be screwed into the implant body. It is the primary component which provides retention to the prosthesis. The parts of an abutment include, the base, which fits into the internal core of the implant, the head, which protrudes and serves as the prosthetic retainer and the collar that is placed at per gingival level and connects the base and the head. Abutment may be of the one piece or the two piece type [6].

Classification of implant abutments

Various types of implant abutments have been reported in the literature for use with the anterior implant-supported restorations. They can be classified according method of connection to the restoration, fabrication material, fabrication method, type of abutment-implant connection, and color [7].

1. Method of connection to restoration

- Screw-retained abutment-crown complex
- Two-piece design with screw-retained crown over the abutment
- Two-piece design with cemented crown over the abutment

2. Abutment connection to implant: – a) External connection b) Internal connection

3. Material – a) Titanium - Cast metal (noble, high noble, or base metal alloy) b) Cast metal

With porcelain fused at the base c) Alumina d) complete zirconia e) Zirconia with a titanium base (zirconia-titanium hybrid abutment).

4. Method of fabrication: - a) Prefabricated (unmodified or modified) b) Customized cast abutment c) Customized copy-milled abutment d) Customized CAD-CAM abutment

5. Color: – a) Gold b) Silver (metallic finish) c) Pure white d) Customized white e) Customized pink/gingival shade at the cervical region.

The various forms of abutments are: standard abutment, estheticone abutment, angulated abutment, ceraone abutment and overdenture abutment.



Fig 1: Abutment Connections

Different types of abutments

Standard abutments

These are cylindrical in shape and are available in various heights with corresponding Ti abutment screws. The base is hexagonal in shape and fits into the implant fixture. They are used for fabrication of edentulous fixed bone anchored bridges. The abutment restoration junction is placed 2mm above the oral mucosa to aid in oral hygiene [8]. There are 2 types of impression techniques

- A. Pick up / open tray impression
- B. Transfer Type / closed tray technique [9].

One uses a tapered impression coping in which, the coping is screwed into the internal screw channel of the abutment and the impression made without removing the coping. The coping is then removed, connected to an analog, inserted into the impression and the cast is poured. The other, uses a square impression coping that contains undercuts which gets locked within the impression. The guide pins are unscrewed and removed from the impression. The latter is a more accurate technique. The base of the impression coping is round. An anti-rotation feature is not necessary for multiple implant restorations. A gold alloy cylinder that fits on top of the standard abutment becomes a part of the final restoration after casting. Gold screws connect the gold cylinder to the abutment. The final restoration is held in place by these gold screws tightened to 10 Ncm [10].



Fig 2: Standard Abutment

Angulated abutments

These incorporate a thirty degree or seventeen degree angulation in their design. They are used to overcome problems associated with implant angulation. The base contains a twelve-sided configuration. They are indicated for multiple implant restorations [11].



Fig 3: Angulated Abutment

Estheticone abutments

These are made of pure Ti with a hexagonal base and are tapered. The three sizes (one, two and three) correspond to the height of the collar in millimeters. They are used for esthetic restorations, multiple implant screw retained restorations, ceramo-metal and cast metal restorations. The restorations are placed 2-3 mm subgingivally and gives a natural look. The technique for its use is similar to that described for standard abutments [12].

Ceraone abutment

These are pure Titanium abutments for cement-retained, single-tooth restorations.

Various collar heights ranging between 1 mm and 5 mm are available. They have a hexagonal base and are connected to the implant by a gold alloy abutment screw with 32 Ncm of force. Plastic impression copings fit by frictional resistance to the abutment and are retrieved with the impression. The analog is placed and the cast poured. Healing caps are placed to maintain soft tissue support. Porcelain is applied to ceramic caps to fabricate all-ceramic single tooth restorations. Temporary or permanent cementation is performed. It is critical to remove excess cement [13].



Fig 4: Ceraone Abutment

Over denture abutment

Abutments for over denture ball attachments are similar to the standard abutment. The male component is a ball head of the abutment screw and the female component is a plastic cap within denture base. The plastic cap uses rubber o-rings that fit over the abutment screw and provides retention [14]. Laboratory analogs are available, giving the option of

incorporating the attachments in the clinical or in the laboratory. It is simple and time saving.



Fig 5: Overdenture Abutments

Abutment types for anterior and posterior implants

1. Standard abutments: These are premade abutments made of Titanium. They consist of two pieces, the abutment and the abutment screw. A variety of heights are available with smooth collars extending from the implant head to the crown margin. Nobel biocare implant - Ceraone, fits a flat top and engages a raised hexagon to give an anti-rotation element for the abutment⁷. The abutment is retained by the implant head using a gold screw. A conical headed (Astratech, Frialit, Straumann) abutment has a matched conical fit surface along with an anti-rotational element. The coronal part of a single tooth abutment, needs adequate retention and resistance for the crown to be retained by cement to the abutment. Other designs (Astratech -single tooth) have a space between the abutment and the crown to allow for cement release. Although their margins do not follow the gingival contour and they are not suitable for labially placed cases, these abutments are simple to use, require, minimal chair side time and offer predictable retention and fit of the crown^[15].

2. Prep able abutments: The retentive element for the crown is a block of metal customized to an ideal preparation. The abutment is prepared using a high speed drill extraorally. The gingival margin follows the gingival contour and is placed subgingivally on the labial aspect and supragingivally on the proximal and palatal aspects. The metal surface that contacts the crown, is left coarse for retention and those that contact the tissue is smoothed. They can be prepared in two ways. One is by producing the abutment and the final crown in one stage. This is used when soft tissue is healthy. A good marginal fit is possible although there is a risk of poor long term retention. The other is by preparing the abutment and provisional crown in the first stage, followed by making the impression with the abutment in place and the final crown, in the second stage.

This method offers a more predictable result although the impression is difficult to make. It is useful if the emergence and the profile of the soft tissue needs to be modified. This technique suits every situation, copes with angulation changes and allows soft tissue remodelling and a good emergence profile. The disadvantages of this technique is that it requires a more complex laboratory technique, second intraoral impressions and offers a less predictable fit of abutment to the crown^[16].



Fig 6: Prefabricated Abutments

3. Fully customized abutments: These are useful in cases of compromised implant positioning. The implant head impression is made and the abutment placed in position on the model. The abutment shape is waxed onto the pattern and then cast⁹ in precious metal. It is possible to move the long axis of final restoration^[17].



Fig 7: Custom Abutment

4. Computer generated abutments: Using computer software, an ideal abutment shape can be generated and viewed in 3 dimensions¹⁰. The implant head impression is made and the working model is placed in a scanner. Readings of implant position and angulation are noted. The position of the gingival margin can be superimposed on the image and sent to a Centre where the abutment is made in Titanium^[18].

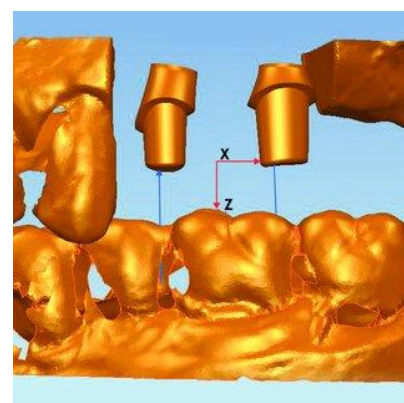


Fig 8: Digital Abutment

5. Ceramic abutments: They are made of dense porcelain. And enjoy a good success rate. They are highly aesthetic. The final crown should be fabricated in all-ceramic & cemented with a tooth colored luting agent. They are not suitable where significant angulation changes are needed [19].



Fig 9: Ceramic Abutment

6. Abutments for screw retained crown: Abutments designed for bridges are used eg. Estheticone-Nobelbiocare, Octa-Straumann. It is necessary to use gold cylinder that has an internal facet that engages the abutment [20].

7. Abutments for cement retained crown: One piece abutments do not engage anti rotational features on the implant body. They are used for multiple splinted implants. The advantages of these abutments include, that no torque wrench is needed, they are stronger, no screw loosening occurs, they are less expensive and it is easy to achieve complete seating. The disadvantages include that they can be used only for multiple abutments and cannot be used for angled abutments. Two piece abutments engage anti rotation features on implant body and the abutment screw fixates the abutment and the implant body. They are used for single tooth implants, in indirect technique for prosthesis fabrication and in angled abutment situations. They provide anti-rotational resistance under shear forces, although screw loosening can occur and torque and counter torque devices are needed [21].

Abutment Designs

These include, threaded (straight, prefabricated angled, custom), frictional (press fit, cold welded) and non-threaded (cementable)

I. Threaded Abutment

a. Straight: Used when axial inclination and parallelism of implants are favourable. Some contain collars (eg. Integral). Some systems require separate Trans epithelial collars (eg. Nobelpharma, IMZ). Calcitek, hexlock and SteriOSS abutments have an anti-rotation design.

b. Pre-fabricated angled: These are not available from all manufacturers. Implant systems that supply them are Integral, SteriOSS, sustain. Implant innovations supplies 15-30 degree angled, one piece, and collared abutments. Steri-oss supplies it in 2 parts, a hexagonal vertical component and a 15-25 degree angled post.

c. Custom abutments (angled & straight): They are made by making impressions or by direct resin patterns. Impressions of internal threading of implants are made with a special transfer post. Impressions are removed, analog attached and cast poured. Angulations, those greater than 25 degree cause excessive force [22].



Fig 10: Threaded Abutment

II. Frictional / Press fit

Stryker & Miter blades, supplies this abutment. Straight and angled variants are available with an angle of 15 degrees. To insert, the head is oriented correctly and tapped firmly with a mallet. It is impossible to remove it after tapping [23].



Fig 11: Press Fit Abutment

III. Non threaded, Cementable

The system using this modality is the Core- Vent design. Abutment selection will not be required until after 2nd stage of surgery.

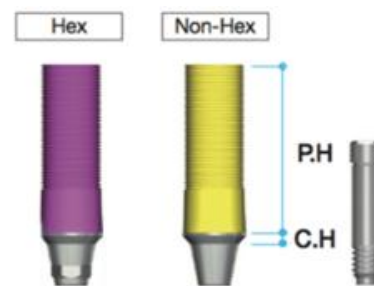


Fig 12: Non Threaded Abutment

Attachment of Abutment to Implants

Current systems use retaining screws for abutment attachments. Abutments for flat surfaced implants demand attachment of 1 piece attachments and are used only in multiple splinted implants. They lack anti rotation features. Abutments for implants with anti- rotation features inhibit unwanted movement. Those in current use include external hex, internal hex, spline attachment and morse-taper attachment [24].

Abutment Selection

The labial margin should extend at-least 1mm subgingivally. If extended more than 3mm, it is difficult to seat the abutment and remove excess cement. In case of discrepancy, a prep able abutment can be used. A vertical space of 3 mm allows for a good emergence profile. If flare is needed in a short vertical space a wide diameter prep able abutment can be used. For a slight labial angulation a standard abutment can be used. For an interocclusal space of 6-7 mm a standard abutment can be used. If lesser space is available a prep able abutment can be

used. A screw type abutment is easier to retrieve whereas a cementable abutment is difficult to retrieve. In cases with special esthetic requirements a porcelain abutment can be used. Final restorations on metal abutments or porcelain abutments should be thick to avoid metal display.

Conclusion

Implants have become the prima dona of the treatment option for the restoration of partially or completely edentulous patients. The implant–abutment interface determines the lateral and rotational stability of the implant-abutment joint, which in turn determines the prosthetic stability of the implant- supported restoration.

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